

REMARKS

Careful consideration has been given by the applicant to the Examiner's comments with regard to the specification and appropriate amendatory action has been taken to correct the relatively minor grammatical matters and to provide the appropriate section headings.

Concerning the foregoing, applicant herewith submits a copy of the specification showing the changes made, as well as a clean copy of the amended specification, noting that no new subject matter has been entered herein.

Applicant further notes the Examiner's rejection of Claims 1-20 under 35 U.S.C. §112, second paragraph, as being indefinite, as detailed in the Office Action.

Moreover, applicant notes the rejection of Claims 1, 2, 5-10 and 12-14 under 35 U.S.C. §102(b) as being anticipated by Hitomi, U.S. Patent No. 6,848,642, as also detailed in the Office Action; the rejection of Claims 15 and 17-20, as being anticipated by Schaeffler, U.S. Patent No. 3,969,039; the rejection of Claim 3 under 35 U.S.C. §103(a) as being unpatentable over Hitomi in view of Schaeffler; and the rejection of Claims 4 and 11 as being unpatentable over Hitomi; whereas Claim 16 has been rejected as being unpatentable over Schaeffler, all of the foregoing being discussed in the Office Action.

Accordingly, upon careful analysis of the prior art, applicant respectfully submits that the claims, as presented herein, clearly and unambiguously distinguish over the art, irrespective as to whether the latter is considered singly or in combination.

In particular, applicant notes that Claims 10-20 have been cancelled herein without prejudice or disclaimer, as being directed primarily to a shaft structure, rather than the piston engine construction, as claimed herein, and the latter of which forms the gist of the invention.

In particular, applicant notes that the present invention is directed to a particular novel aspect in that at least one of the pivot bearings is a cylindrical roller bearing, which may be a needle bearing, and wherein the inner race of the bearing is only centrally supported on a shaft of the piston engine, as clearly disclosed in Figures 4 and 5 of the drawings, whereby the at least inner race of the bearing is pre-stressed so that in conjunction or assembly with the central support thereof on a bearing portion of the shaft, the inner race assumes a convex contour of the outer running surface thereof. Thereby, the convex contour of the running surface of the inner race is already evident, even under conditions when the shaft is not bent or deflected during operation of the piston engine.

Pursuant to the present invention, as clearly described, and claimed, there are provided significant advantages in assuming the convex contour of the effect of the inner race through the unique pre-stressing thereof, as also described in detail in the present specification, and that the cylinder roller bearing, which at times may be a needle bearing due to reasons of space constraints, is utilized for the support of the shaft of a hydraulic piston machine. These needle bearings are, in industry, generally broadly designated as “cylinder roller bearings”, as also incorporated herein in the language of the amended claims.

Hereby, in the event that a shaft, which is supported in a usual needle bearing, is bent, then its support section, and thereby also the inner race of the needle bearing, may be tilted or deflected. Consequently, the inner race and the outer race of the needle bearings are tilted relative to each other, and this produces an increased amount of wear along the edges of the needles, and on the mutually facing running track of the bearing races in the region along the edges of the needles.

In order to avoid the drawbacks which are encountered in such structures, the present invention provides for a unique support arrangement between the shaft and such a cylinder roller bearing, in effect, (which may be a needle bearing), as disclosed in particular in Figures 4 and 5 of the drawings. Hereby, the inner race of the cylinder roller bearing is supported by the shaft only in the central portion and with a pre-stressing having been previously imparted thereto, whereby the outer surface of the bearing inner race, when considered in a cross-sectional view extending parallel to the axis of the inner race, assumes a convex contour. As a result thereof, the inner race can tilt or deflect with the shaft without that its running path will be forcibly pressed with an increased amount of force against an edge of the needles. Moreover, additionally, between the running track of the outer race and the needles, there also is not encountered any kind of increased pressure along the edges thereof, inasmuch as the needles orient themselves in their position to the running track of the outer race. Predicated on the foregoing, as mentioned hereinabove, the present invention is concerned with providing this unique central support of the inner race which has been pre-stressed on a portion of the shaft, whereby the inner race has at least the outer surface thereof shaped into a convex configuration, as shown in Figures 4 and 5 of the drawings. Hereby, the inner race, at its bearing surfaces, can contact against the shaft so that no radial play or tolerance is present between the inner race and the shaft. Even when play or tolerance would be present, this would not display any kind of display of movement, since this would require the needles to deform the inner race, which they are not capable of effecting.

The foregoing inventive aspects are now clearly and unambiguously emphasized in the claims, noting that none of these features can be ascertained in any of the references applied or cited by the Examiner.

Reverting to the prior art, applicant notes that none of the publications are even remotely concerned with the inventive aspects of the present invention, particularly as claimed herein.

In contrast with the core of the present invention, from which there can be obtained the aspect that, essentially, the radial play of movement between the inner race and the shaft in the outer axial regions of the inner race, will not lead to radial compressive stresses in the end regions of the bearing section of the shaft, inasmuch as the bearing section, upon a bending of the shaft, can move into the open spaces or clearances, as described on Page 7, lines 14-18 of the present specification. That type of capability of movement is not provided for by the present invention and is also not considered to be necessary; because the inner race of a roller bearing is usually fixedly seated on the shaft so that an inclined position the shaft at the end surfaces of the inner race provides an increased pressure, but due to the lack of any relative movement between the shaft and the inner race, cannot lead to an edge movement. Moreover, pursuant to the invention, the inner race of the needle bearing, subsequent to assembly with prior pre-stressing, is convexly deformed and fixedly seated on the shaft.

The disclosure of the prior art cannot be correlated with the subject matter of the present invention, in that it already is known as set forth on Page 7, lines 8-10, whereby the inner race of the needle bearing is seated with a usual fit on the shaft. A usual fit would not lead to the desired deformation of the inner race, as set forth and claimed herein. Pursuant to the present invention, as also described in the specification, there is disclosed a thermal heating between the inner race and the shaft. The present concept also indicated that the inner race was heated or, conversely, the shaft cooled down, and then both parts are fitted together. Through the following balancing or equalization of the temperatures, there has been obtained the pre-stressing between the inner race and the shaft and the consequent convex deformation of the inner race, as also described in

the specification, leads to the advantages in an extended service life and reduced wear, through the convex shapes which have been shown in Figures 4 and 5 of the drawings.

With respect to the primary reference of record, applicant respectfully submits that the present piston machine, as set forth and claimed in the amended claims, is not in any manner anticipated nor rendered obvious by Hitomi, U.S. Patent No. 6,848,642 A, which provides for a pivot lug or the like.

Furthermore, none of the secondary references of record disclose the type of structure and support, as provided for by the present invention.

For example, Schaeffler only discloses a curved bearing inner race, which does not provide for a convexly curved pre-stressed structure analogous to the present invention, but merely provides for point-like contact enabling the bearing to tilt relative to the shaft. This has nothing in common with the present invention.

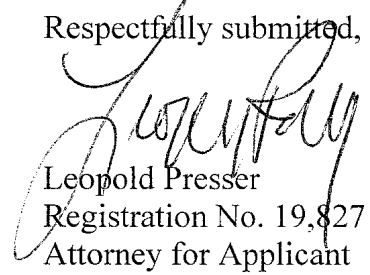
Moreover, providing the splined or grooved structure in Hitomi with regard to the shaft construction has nothing in common with the present convex curvature and pre-stressing of the inner race of a cylinder roller or needle bearing.

In summation, the amended claims, as presented for the Examiner's consideration herein, have been clearly directed to the inventive concept, as described hereinabove, and are deemed to obviate the formal grounds of rejection, while concurrently distinguishing over the art, irrespective as to whether the latter is considered singly or in combination.

In view of the foregoing comments and amendments, the early and favorable reconsideration of the application by the Examiner and issuance of the Notice of Allowance is earnestly solicited.

However, in the event that the Examiner has any queries concerning the instantly submitted Amendment, applicant's attorney respectfully requests that he be accorded the courtesy of possibly a telephone conference to discuss any matters in need of attention.

Respectfully submitted,



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Attachments: Marked-up version of Specification; and
 Clean version of Specification.